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I, KAY WARD, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PP 7910 for a patent by GOYEN CONTROLS CO PTY LTD filed on 23 December 1998.

WITNESS my hand this
Fifteenth day of February 2000

KAY WARD
TEAM LEADER EXAMINATION
SUPPORT AND SALES

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AUSTRALIA

Patents Act 1990

PROVISIONAL SPECIFICATION

Invention Title: **AIR FLOW CONTROL VALVE**

The invention is described in the following statement:

Air Flow Control Valve

Field of the invention

This invention relates to a diaphragm operated air flow control valve of the type typically used in the dust collector industry. The valve of the invention will be suitable for use in that industry, but it is to be understood that the valve of the invention can be used in other applications as well.

Background of the invention

Air flow control valves used in the dust collection industry have a series of reasonably specific design constraints which they must meet in order to operate effectively. For example, typically the valves have inlets and outlets arranged at 90° to each other, the valves are typically electronically controlled, and the supply and outlet pipes which lead towards and away from the valve are typically either 20mm, 25mm or 45mm in diameter.

Typically these valves have a valve closure member mounted to a diaphragm and by controlling the pressure on opposite sides of the diaphragm the valve can either be opened or closed. The pressurised air supply provides the necessary pressure for controlling the valve and a bleed arrangement is provided for supplying air under pressure to opposite sides of the diaphragm.

Since these aspects of the valves are well-known, they need not be described in this document in any great detail.

There are important performance characteristics which such valves must meet in order to be competitive in the industry. For example, the valves must open rapidly and there must be a minimum pressure drop across the valve when the valve is open. In addition, the valves should be relatively easy to manufacture, assemble and install, and maintenance of the valves should be possible without removing the valve body from the equipment onto which it has been installed.

Summary of the invention

According to one aspect of the invention there is provided an air flow control valve comprising:
a valve body having an internal cavity and an inlet and outlet in flow communication with the internal cavity, the axes of the inlet and outlet being aligned at substantially 90° to each other;

a valve seat located within the cavity and co-axially aligned with the outlet, the valve seat being located on the distal end of an upstanding tubular pedestal which is formed around the outlet;

5 the internal cavity being configured so as to define an annular space around the pedestal with which the inlet is in flow communication;

a flexible generally planar diaphragm mounted above the valve seat, the diaphragm supporting a valve closure member which is adapted to engage the valve seat to close the valve;

10 valve control means for causing the diaphragm to move towards and away from the valve seat to close and open the valve respectively; and

the valve being characterised in that, with the valve oriented with the inlet axis horizontal and the outlet facing downwards, the valve seat is located at an elevation at or below the upper most edge of the inlet, and the diaphragm is located at an elevation above the upper most edge of the inlet.

15 Preferably the upper most edge of the valve seat is located a distance which is approximately one third the diameter of the inlet above the centre line of the inlet.

20 Preferably the valve body is comprised of a bowl portion in which the inlet and outlet are located, and a cap portion in which the valve control means is located, the cap portion having screwed threads thereon adapted to engage with cooperating screw threads on the bowl portion, the diaphragm being capitively held in position between the cap portion and the bowl portion when the cap portion is operatively screwed onto the bowl portion. The screw threads on the bowl portion are preferably of female configuration, and the threads on the cap portion are preferably of male configuration.

25 A further feature of the invention provides for the area of the annular space relative to the area of the valve seat to be in the range of 2.5:1 to 4.5:1, and preferably in the range of 3.2:1 to 3.6:1.

The internal diameter of the valve seat is preferably larger than the internal diameter of the outlet, and the inner wall of the tubular pedestal preferably tapers convergently from the valve seat towards the outlet.

The inlet and outlet may have any suitable connection arrangement for connecting air flow conduits to the valve. In one arrangement the inlet and outlet both comprise an internally threaded socket adapted to each receive a respective externally threaded tubular conduit.

The diaphragm may have a bleed hole therethrough adapted to feed pressurised air from the annular space into the area above the diaphragm. Optionally the diaphragm may be spring-loaded into engagement with the valve seat.

Further features of the invention will be made apparent from the description of two embodiments thereof given and below by way of examples. In the description references made to the accompanying drawings, but the specific features shown in the drawings should not be construed as limiting on the invention.

Brief description of the drawings

Figure 1 shows an exploded cross-sectional side view of an air flow control valve according to the invention;

Figure 2 shows an enlarged cross-sectional side view of the bowl portion of the valve body;

Figure 3 shows a perspective view of a slightly different embodiment of valve according to the invention with the cap portion removed from the body portion; and

Figure 4 shows an end view of the bowl portion of the body of the valve shown in Figure 3.

Detailed description of the embodiments

It will be understood that the invention disclosed and defined herein extends to all alternative combinations of two or more of the individual features mentioned or evident from the text or drawings. All of these different combinations constitute various alternative aspects of the invention.

Referring initially to Figure 1, a flow control valve according to the invention comprises a valve body 10 having a bowl portion 12 and a cap portion 14 which in use is mounted to the bowl portion 12. The cap portion will, in use, hold a diaphragm assembly 16 to the body portion 12. The valve is controlled by a solenoid operated plunger assembly 18 which includes a plunger 20, compression spring 22 and a retaining clip 24. These components are well known and need not to be described herein in any greater detail.

The diaphragm assembly 16 comprises a flexible circular diaphragm 55 which has a valve closure member 20 mounted thereto by means of a fastener 22 and backing plate 24. The

diaphragm 55 has a bleed passage 26 therethrough through which pressure differentials on opposite sides of the diaphragm 55 are equalised. A compression spring 28 urges the diaphragm away from the cap portion 14. The plunger 20 has a rubber cap 30 on its lower most end which is adapted to seal with a nozzle 32 which in use is mounted to the cap portion 14.

- 5 The bowl portion 12 has an inlet 34 and an outlet 36 both of which are in flow communication with an internal cavity 38. The internal cavity 38 is of circular or bowl shaped configuration. A valve seat 40 which is coaxial with and surrounds the outlet 36 is formed on the bowl portion 12. The valve seat 40 is located on the upper or distal end of a tubular pedestal 42 which surrounds the outlet 36. The pedestal 42 serves to lift the valve seat 40 adjacent the under side
10 of the diaphragm assembly 16 which will be mounted against an annular seat 44 formed on the body portion.

Turning to Figure 2 of the drawings, the body portion 12 is shown in more detail. The configuration of the body portion 12 achieves significant efficiencies for the valve.

- The inlet 34 of the body portion 12 has a centre line 45 which, when the body portion is aligned
15 as shown in Figure 2, that is with the centre line horizontal and the outlet 36 facing downwardly, the valve seat 40 is located below the upper most edge 46 of the inlet 34. In other words, the valve seat 40 is relatively close to the centre line 45 of the inlet 34. In the arrangement shown in Figure 2, for example, where the inlet diameter 34 is approximately 24mm, the dimension "d" is approximately 9mm which is significantly less than the applicant's
20 prior art valve arrangements which is approximately 20mm. The dimension between the diaphragm seat 44 and the valve seat 40 has also been increased. In the applicant's prior valve that dimension was approximately 6mm whereas in the current design that dimension is approximately 9mm. However, the applicant is of the view that it is the lowering of the valve seat 40 in relation to the inlet port centre line which has significantly improved the efficiency of
25 the valve. The effect of these dimensional changes is that when the valve is open a relatively large opening is achieved between the diaphragm and the valve seat, and the valve seat is also located within the direct flow path of air flowing from the inlet to the outlet. This ensures a significantly lower pressure drop across the valve.

- In addition to lowering the valve seat the applicant has also increased the diameter of the
30 annular space 46 around the pedestal 42. This has been achieved by an increase in the diameter of the body portion 12. This larger bowl area allows for a straighter flow path of higher pressure air across the valve seat 40 and into the outlet 36 when the valve is open. Furthermore, this

arrangement provides a higher static pressure recovery (due to lower air velocity around the bowl) inside the bowl. The higher the static pressure inside the bowl, the better the flow across the seat when the valve is open.

These new configurations in the valve body have helped to achieve approximately 40% flow improvement (Kv) against applicant's own prior art valve of similar dimensions. The attached Table 1 sets out a comparison of applicant's new valve (those marked with an arrow) and certain of the applicant's comparable prior art valves. Clearly, the applicant does not in any way wish to be bound to any of the dimensions or ratios listed in Table 1 but those dimensions indicate certain of the differences between the prior art valves and the current development valve which have gone towards achieving this significant improvement in flow performance.

Other significant improvements with the valve are that the cap portion 14 has a male threads 48 which engage in female threads 50 formed in the body portion. This allows the cap portion 14 to be screwed onto and off the body portion for quick assembly and maintenance. The plunger assembly, likewise, is simply fitted to the cap portion by the clip 24 which engages in a groove 52.

It will be appreciated that the valve seat 40 could be lowered even closer to the centre line 45 of the inlet. This could be achieved by, for example, increasing in the thickness of the valve closure 20, thereby bringing the contact face of the valve closure member 20 closer to the valve seat 40. Also, the increased bowl diameter has the effect of increasing the diameter of the diaphragm 55 allowing more movement of the diaphragm 55 and therefore permitting the valve seat 40 to be located a greater distance away from the valve closure member 20 than is the case with small diameter diaphragms.

It will be appreciated that maintenance of the valve can take place in a relatively simple fashion. To maintain the valve after it has been installed onto equipment the cap portion 14 is simply screwed off the body portion 12 allowing the diaphragm assembly 16 to be removed and replaced as necessary. The plunger assembly 18 can, similarly, be removed from the cap portion by releasing the clip 24. This is a simple operation and allows for far quicker maintenance and inspection than is the case where a series of bolts or screws are used to hold down the cap and the plunger assembly.

It will be appreciated that the simplicity of the valve also enables the valve to be easily and rapidly assembled during manufacture. In addition, the simplicity of the design has

significantly reduced the number of parts of the valve and this has therefore reduced the cost of the valve.

Clearly, many variations may be made to the above described embodiments without departing from the scope of the invention. The embodiment shown in figures 3 and 4 depicts an arrangement in which the inlet and outlet have external threads 54 thereon to allow for a different type of connection arrangement to the air conduits. However, the arrangement shown in figures 3 and 4 employ the same valve seat configuration which, it will be noted from figure 4, is located below the upper edge 46 of the inlet.

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Dated this 23rd day of December 1998

**Goyen Controls Co Pty Ltd
by its attorneys
Freehills Patent Attorneys**

TABLE 1

CAS Valve Dimensional Comparisons										File:c:\word\1706\valve1.xls						
14th Dec 98																
#1 Valve	#2 Seat ID mm	#3 Seat OD mm	#4 Seat Area (Based on ID) mm ²	#5 Bowl ID mm	#6 Bowl Area mm ²	#7 Seat Area Bowl Area	#8 Bowl area/ Seat area	#9 Outlet Pipe ID mm	#10 Outlet Pipe Area mm ²	#11 Seat Area/ Pipe Area	#12 Lift mm	#13 Lift Area mm ²	#14 Lift Area/ Pipe Area	#15 Inlet C/L line to Seat Ht mm	#16 Inlet port dia mm	#17 % port dia exposed
25FS-3	35.00	42.00	962.11	77.00	3271.18	0.29	3.40	26.60	555.72	1.73	8.00	879.65	1.58	14.30	39.40	13.17
25FS std	31.50	42.00	779.31	64.00	1831.55	0.43	2.35	26.60	555.72	1.40	6.00	593.76	1.07	30.80	39.40	27.38
20FS-3	27.50	32.50	593.96	60.00	1997.85	0.30	3.36	20.90	343.07	1.73	6.00	518.36	1.51	9.00	26.00	15.38
20FS std	23.00	27.40	415.48	51.30	1477.28	0.28	3.56	20.90	343.07	1.21	5.55	401.02	1.47	19.50	25.20	27.38
20DD-3	27.50	32.50	593.96	60.00	1997.85	0.30	3.36	20.90	343.07	1.73	6.00	518.36	1.51	9.00	25.00	14.00
20T-3	27.50	32.50	593.96	60.00	1997.85	0.30	3.36	20.90	343.07	1.73	6.00	518.36	1.51	9.00	23.90	12.34
20T,DD-std	20.50	25.80	330.06	50.80	1504.04	0.22	4.56	20.90	343.07	0.95	3.70	238.29	0.89	15.20	23.00	16.09
45FS-3	55.00	63.50	2375.83	120.00	8142.80	0.29	3.43	40.90	1313.82	1.81	12.00	2073.45	1.58	15.00	50.00	20.00
45FS std	53.50	63.50	2248.00	95.50	3996.10	0.56	1.78	40.90	1313.82	1.71	9.37	1574.86	1.20	27.90	50.00	15.80
45T,DD std	50.80	59.00	2026.83	95.50	4429.05	0.46	2.19	40.90	1313.82	1.54	8.87	1415.59	1.08	37.80	50.00	25.60
Calculation Key: Column #										Comment						
										4		Seat Area is based on Seat ID				
										6		Bowl area is based on (bowl ID - seat OD)				
										9		Outlet Pipe Area is based on schedule 40 pipe ID				
										13		Lift area is based on seat ID and lift				
										15		Height from Inlet port centreline to diaphragm flange				
										16		Only 25FS-3 dimension quoted against 25FS/T/DD-3 row				
										17		Based on % of port diameter(not area) exposed above body seat				

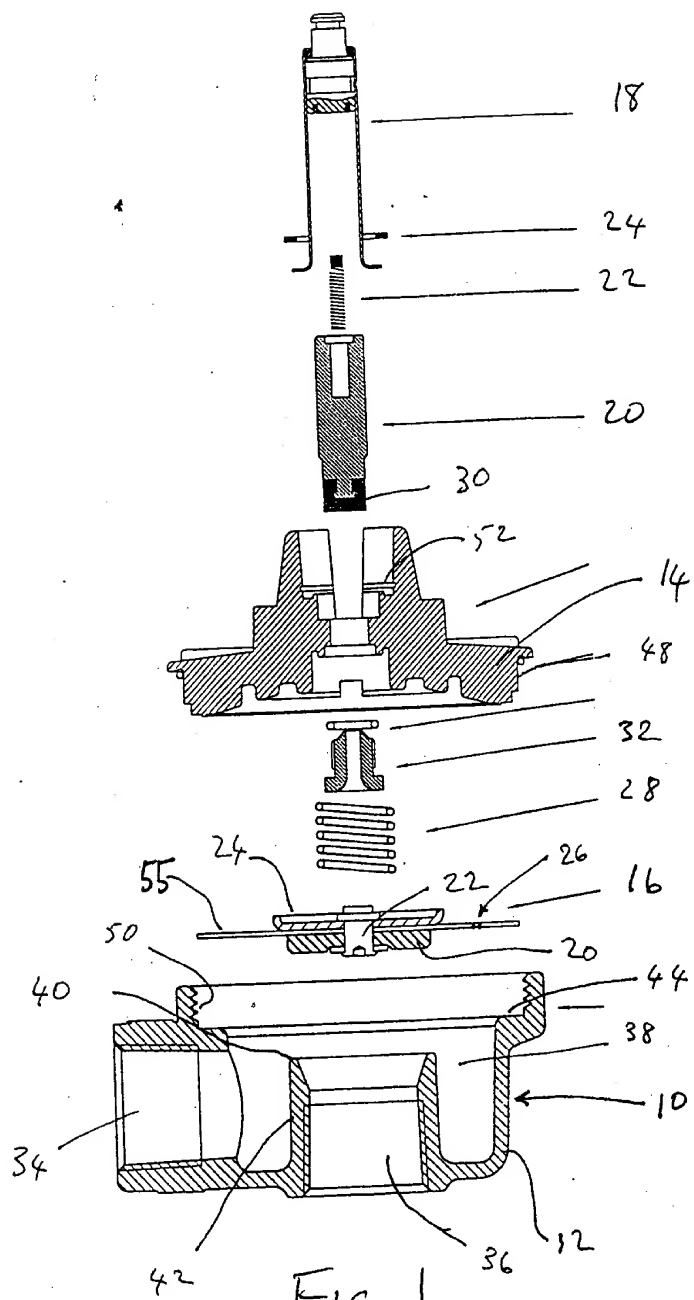


Fig 1

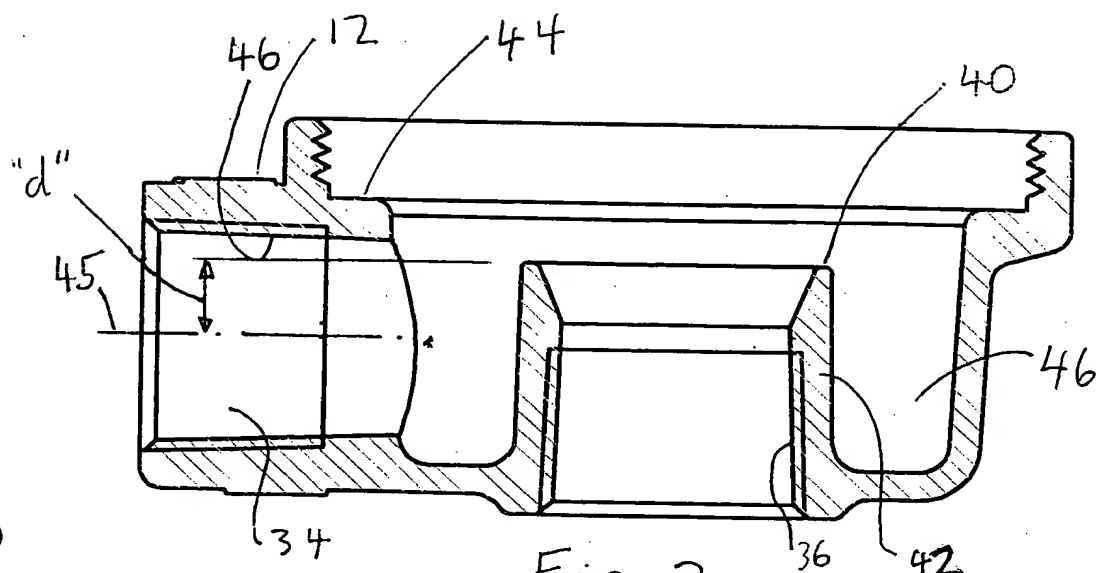


Fig 2

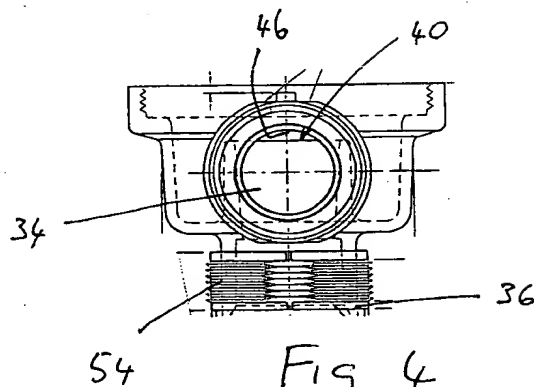


Fig 4

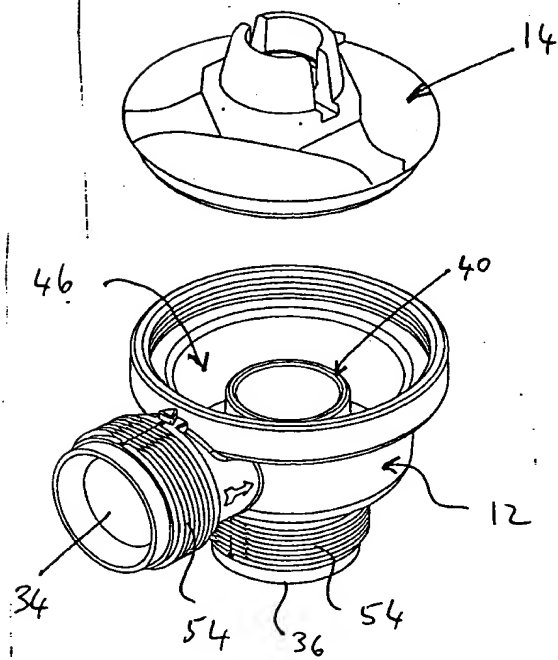


Fig 3

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